

IAP20 Rec'd PCT/PTO 30 JAN 2006**FUEL INJECTOR**

Background Information

The present invention is based on a fuel injector of the type set forth in the main claim.

From EP 0 828 075 A1, for example, a fuel injector for the direct injection of fuel into the combustion chamber
5 of an internal combustion engine is known, which has a device for adjusting the temperature in the region of the valve tip so as to reduce deposits in this area. The device is embodied in the form of a coating made of a thermally conductive material on the valve tip.

10 Disadvantageous in the fuel injector known from EP 0 828 075 A1 are the high demands regarding the accuracy of fit of the components and the complicated installation, which is involved and thus cost-intensive.

Furthermore, a fuel injector for the direct injection of
15 fuel into the combustion chamber of a mixture-compressing internal combustion engine having external ignition is known from DE 101 09 407 A1. It includes a valve housing formed by a nozzle body, and a sealing ring which seals the fuel injector from a cylinder head of the internal
20 combustion engine. The sealing ring has a convexly arched profile, the two ends of the sealing ring axially overlapping in the form of a step.

Particularly disadvantageous in the fuel injector known from DE 101 09 407 A1 is the air gap between the fuel
25 injector and the cylinder head, which allows an only limited heat transfer. This is disadvantageous in reducing deposits on the valve tip since the temperature

in the region of the spray-discharge orifices must be as low as possible so as to avoid deposits.

Summary of the Invention

In contrast, the fuel injector according to the present invention, having the characterizing features of the main claim, has the advantage that a seal is situated between the cylinder head and the nozzle body, the seal extending over the entire axial length and having a suitable structure, thereby providing not only a reliable sealing effect but effective heat dissipation away from the nozzle body as well.

Advantageous further developments of the fuel injector specified in the main claim are rendered possible by the measures delineated in the dependent claims.

It is particularly advantageous that any desired cross sections are possible, for instance corrugated tubes, convoluted bellows and smooth tubular bodies having protuberances formed in a variety of shapes.

In an advantageous manner the seal may also be made up of a plurality of layers, which gives it higher stability and makes it less likely to be damaged during the installation.

In addition, it is advantageous that a cover plate, which functions as heat shield, may be situated on a discharge-side end of the seal. The cover plate may have an opening for the spray-discharged fuel jets or it may have a plurality of spray-discharge openings.

The seal is advantageously produced from a metallic material having an amorphous structure, so that a smooth surface is able to be achieved.

Brief Description of the Drawing

Exemplary embodiments of the present invention are shown in a simplified version in the drawing and elucidated in greater detail in the following description.

5 The figures show:

- Fig. 1 A schematic section through a fuel injector according to the related art;
- Fig. 2 A schematic, part-sectional view of a first exemplary embodiment of a fuel injector according to the present invention;
- 10
- Fig. 3 A schematic, part-sectional view of a second exemplary embodiment of a fuel injector according to the present invention;
- 15
- Fig. 4 A schematic, part-sectional view of a third exemplary embodiment of a fuel injector according to the present invention;
- 20 Fig. 5 A schematic, part-sectional view of a fourth exemplary embodiment of a fuel injector according to the present invention;
- Fig. 6 A schematic, part-sectional view of a fifth exemplary embodiment of a fuel injector according to the present invention; and
- 25
- Fig. 7 A schematic, part-sectional view of a sixth exemplary embodiment of a fuel

injector according to the present invention.

Description of the Exemplary Embodiments

Before preferred exemplary embodiments of a fuel injector
5 1 according to the present invention are described in
greater detail with the aid of Figures 2 through 7, for a
better understanding of the present invention a fuel
injector 1 according to the related art shall first be
briefly explained in terms of its essential components on
10 the basis of Figure 1.

Fuel injector 1 is configured in the form of a fuel
injector for fuel-injection systems of mixture-
compressing internal combustion engines with externally
supplied ignition. Fuel injector 1 is suited, in
15 particular, for the direct injection of fuel into a
combustion chamber 2 of an internal combustion engine.

Fuel injector 1 includes a nozzle body 3, which is sealed
from a cylinder head 5 of the internal combustion engine
by a sealing ring 4. Sealing ring 4 is made of, for
20 instance, an elastomeric material such as a Teflon-coated
material and provides the sealing effect in cylinder head
5 as a result of a slightly larger diameter compared to
nozzle body 3.

Furthermore, fuel injector 1 includes a housing 6, an
25 electric plug-in contact 7 for actuating fuel injector 1,
and a fuel feed 8 via which the fuel is conveyed. Fuel
may be supplied via a fuel-distributor line, for example,
which is not shown further.

Disadvantageous in the sealing rings 4 known from the
30 related art is, in particular, the poor heat transfer
between nozzle body 3 and cylinder head 5 because of an
air gap 9 on the discharge side between fuel injector 1

and cylinder head 5. In order to counter the threat of coking of the spray-discharge orifices of directly-injecting fuel injectors 1 as a result of the high temperatures in combustion chamber 2, the lowest possible temperature is to be desired in the region of the valve tip. This counteracts a complete evaporation of the fuel remaining in the region of the valve tip after the injection process. If the fuel remains liquid, the combustion residue and impurities are unable to deposit in the region of the valve tip and are carried away during the next injection cycle.

The poor heat transfer between fuel injector 1 and cylinder head 5 is counteracted by a seal 10 configured according to the present invention, as illustrated in preferred exemplary embodiments in Figures 2 through 7.

Seals 10 described below all have in common that they are designed as corrugated tubes and thus not only provide excellent sealing action but also offer a sufficiently large contact surface for an effective heat transfer between fuel injector 1 and cylinder head 5. Seals 10 are designed in such a way that they are short and broad in the non-installed state and are pressed together slightly by the installation and become longer as a result. This makes it possible to achieve an excellent fit.

Seals 10 are made of a material that exhibits great thermal conductivity such as a metal foil having an amorphous structure, so that it is possible to achieve a very smooth surface with the advantage of a simple and damage-free installation.

Cavities 16 formed between fuel injector 1 and seal 10 by the different cross-sectional forms may be used for passing through a coolant.

In the following, exemplary embodiments for fuel injectors 1 provided with corresponding seals 10 will be described by way of example. With the exception of the measures according to the present invention, fuel injectors 1 may be designed similar to fuel injector 1 illustrated in Figure 1.

Figure 2 shows a first exemplary embodiment of a fuel injector 1 configured according to the present invention. Here, in the simplest manner, seal 10 has the form of a corrugated tube. Seal 10 is open at both sides and is thus able to be mounted in an especially uncomplicated manner. Seal 10 may be premounted on nozzle body 3 of fuel injector 1 and then inserted into cylinder head 5 together with it.

Figure 3 shows a second exemplary embodiment of a fuel injector 1 configured according to the present invention. In this exemplary embodiment seal 10 has the form of a tubular seal 10 having protrusions 11. Protrusions 11 are approximately semicircular in section. The advantage of this variant is a slightly larger contact surface on nozzle body 3 resulting in improved thermal conductivity.

Figure 4 shows a third exemplary embodiment of a fuel injector 1 configured according to the present invention. In this case seal 10 has a pleated design and has been formed into expansion bellows 10. The thermal conductivity and sealing ability correspond approximately to that of the first exemplary embodiment described in Figure 2.

Figure 5 shows a fourth exemplary embodiment of a fuel injector 1 configured according to the present invention. Here, seal 10 is made up of a plurality of layers 12 in a sandwich-like manner. This increases the durability of seal 10, in particular, which is unable to deform as

easily during installation and thus is less likely to be damaged. The individual layers 12 may in turn be designed in the form of a corrugated tube and be bonded to each other, or they may be joined to each other only at their
5 ends.

Figure 6 shows a fifth exemplary embodiment of a fuel injector 1 configured according to the present invention. Here, seal 10 may have the same cross-sectional design as seals 10 according to the exemplary embodiments
10 illustrated in Figures 2 through 5, the corrugated tube design having been chosen in Figure 6. In addition, on a discharge-side end 13, it is provided with a cover plate 14 which has an opening 15 for the fuel jets injected into combustion chamber 2 from at least one spray-
15 discharge orifice of fuel injector 1. Cover plate 14 additionally has the function of a heat shield and protects the spray-discharge orifices from the high temperature prevailing in the combustion chamber, the high temperatures increasing the coking tendency of the
20 spray-discharge orifices.

Figure 7 shows a sixth exemplary embodiment of a fuel injector 1 configured according to the present invention. Here, as in the exemplary embodiment shown in Figure 6, seal 10 may have the same sectional design as seals 10
25 illustrated in Figures 2 through 5, the corrugated tube design having been chosen in Figure 7 as well. Seal 10, too, has a cover plate 14 on a discharge-side end 13 into which the spray-discharge orifices may be worked directly. Cover plate 14 also assumes the function of a
30 heat shield and protects the discharge-side end of fuel injector 1 from the temperature prevailing in the combustion chamber.

The present invention is not restricted to the exemplary embodiments shown, but is also applicable to other cross-sectional forms of seals 10, as well as to a wide variety of construction types of fuel injectors 1, such as fuel
5 injectors 1 having an interface to an intake manifold or a common-rail system.

In particular, the individual features of the various exemplary embodiments may be combined with each other as desired.